"Aquatic Mammals", Vol. 8 no. 1, June 1980.

SOME CASES OF SYNECHIA ANTERIOR IN AQUATIC MAMMALS

A.D.G. Dral, Netherlands Institute for Sea Research, Texel, The Netherlands.
F.C. Stades D.V.M., Small animals clinic, State University of Utrecht, Yalelaan 8, Utrecht, The Netherlands. A.W.van Foreest D.V.M., Ouwehand Zoo, Rhenen, The Netherlands.

Introduction

Corneal opacities are found frequently in marine mammals. In some cases (maybe more than we are aware of) the opacities can be attributed to a synechia anterior, i.e. a growing together of the iris with the inner surface of the cornea. As proposed by BELLHORN c.s. (1977) one of the causes may be the very shallow anterior chamber which characterises the aquatic mammal's eye. During miosis (contraction of the pupil) the distended iridial vessels might touch and damage the inner corneal tissues.
In this paper we present some cases and discuss the theory of the iris/corneal touch syndrome.

a. Synechia anterior in *Sotalia fluviatilis guianensis*

In April 1979 three dolphins, *Sotalia fl. guianensis,* were caught in Columbia and transported by plane to Ouwehands Zoo at Rhenen, The Netherlands. On arrival the animals were in good condition and there were no signs of disease. The animals were placed in a rectangular pool (3 x 6 m, 4 m deep). They received a preventive antibiotic treatment before, during and a week after arrival.
Two animals behaved normally, the third one (Champagne, a subadult male) was observed to bump against the wall of the pool now and then. When the training started Champagne appeared to behave abnormally in more respects. He did not touch a fish if it was offered with the hand in a certain position. On jumping over a stick an oblique course was sometimes followed, occasionally risking a landing outside the pool. Initially, problems in adaptation or with the sonar system were supposed; it became clear, however, that malfunction of the visual system caused the troubles.
On eye examination in July 1979, the animal's right eye appeared to be in serious trouble. The cornea was highly vascularised and the interior of the eye was opaque, so that we could not observe the fundus.
Also the left eye showed some vascularisation of the cornea, but the interior was clear. This eye was obviously in a much less bad condition. No therapy was given.
Re-examination after a five-month period revealed that the right eye had improved considerably. Some deep vessels still remained in the dorsal and rostral quadrants of the cornea, which ended in a small pigment deposit on the endothelial surface. The corneal surface showed

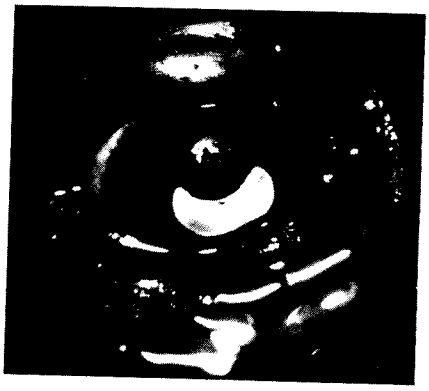

Fig. 1. Frontal view of the right eye of *Sotalia fluviatilis guianensis,* December 1979.

some unevenness slightly dorsal from the centre, right over the iris operculum. In that area as well as in dorso-rostral locations the corneal tissue had become opaque by scar formation. A horizontal stripe-shaped scar was clearly visible at the rostral side (Fig. 1).
Slit lamp biomicroscopy (Kowa, Japan) revealed that at the tip of the operculum the tissues of iris and cornea had fused. As a consequence of this synechia administration of 0.5% tropicamide (Mydriaticum ^{R}, Bournonville-Pharma, Holland) had hardly any effect on the state of miosis. The small area of the right eye fundus, which could be observed, was apparently normal. The cornea of the left eye also showed a slight invasion of capillaries, together with some scar formation and corneal surface irregularity. By slit lamp biomicroscope a space of about 1 mm between iris and cornea was estimated.
In the meantime the animal's behaviour had changed to normal. Apparently the condition of its eyes did no longer cause any inconveniences.

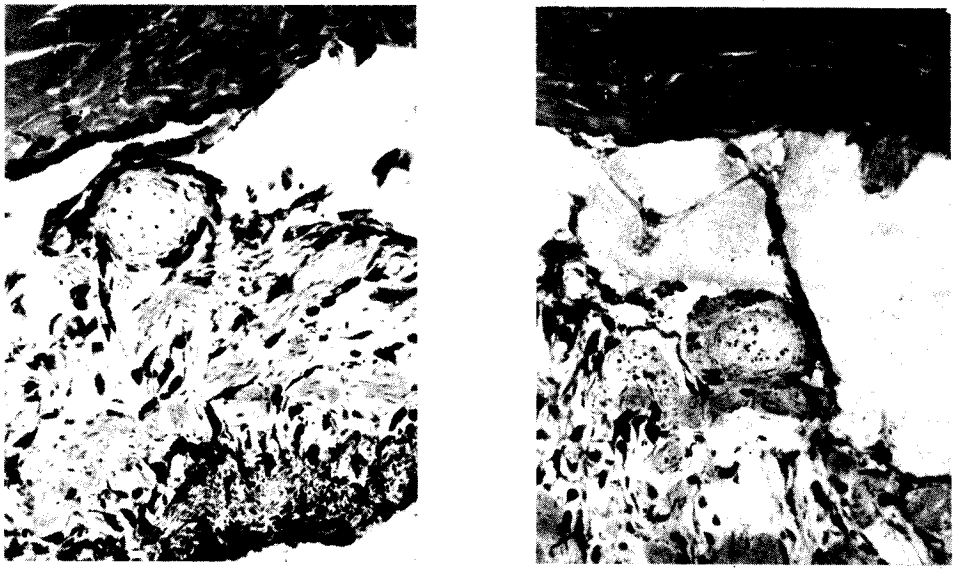

Fig 2. Sections showing the synechia anterior in *Inia geoffrensis.*

b.Synechia anterior in *Inia geoffrensis*

By kind mediation of Dr. W. Gewalt we received the preserved eyes of an Amazon dolphin *(Inia geoffrensis),* which had died in the Duisburg Zoo. During life the animal had not caused any reason to give special attention to its eyes. After sectioning, one of the eyes appeared to have an extended synechia anterior (Fig. 2). At the places of fusion the endothelium and Descemets's membrane had disappeared and the corneal and iridial collagenous tissues had become continuous. Especially at these locations, but also alsewhere, the corneal stroma contained many melanophores, while the lamellae had lost much of their regular arrangement. Both factors must have lent an opaque appearance to the living cornea. As a rule, some blood capillaries are present in the corneal stroma of *Inia.* In this eye capillaries seemed to be present in some greater extend than is usual.
Clearly, preceeding the stage in which we found the eye, some inflammatory process must have existed. It apparently had recovered completely and most probably the disease occurred while the animal still lived in the wild.

c. Synechia anterior in *Phoca hispida sibirica*

The left eye of a Baikal seal with corneal ulcer had to be removed because of great discomfort

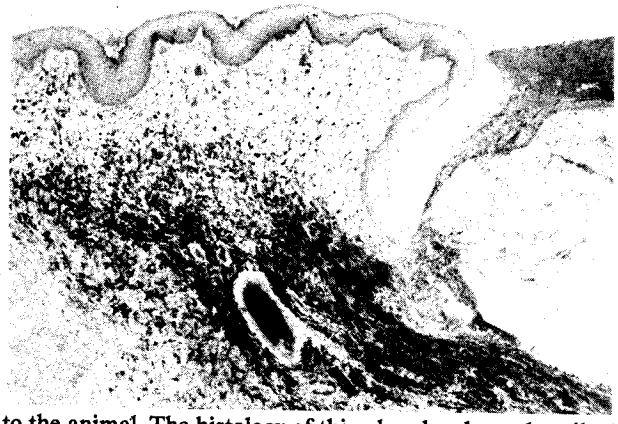

Fig. 3. Inflammated corneal and iridial tissues in *Phoca hispida sibirica.*

to the animal. The histology of this ulcer has been described elsewhere (BEUMER c.s., 1972). The eye was in complete disorder internally. With respect to its anterior part (Fig. 3), at extended areas no boundary could be observed between the highly inflammated tissues of the cornea and the disordered iridial tissues. Obviously an extended synechia anterior had preceeded or accompanied the final troubles of the eye. Owing to the accommodative function and essential mobility of the iris in pinnipeds, any synechia in these animals must have more serious consequences than in cetaceans.

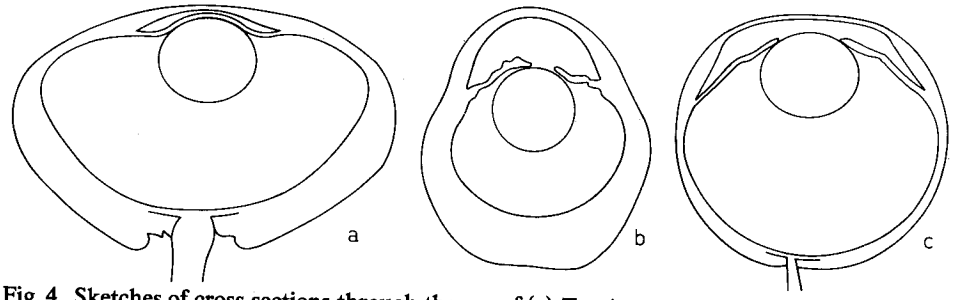

Fig. 4 Sketches of cross sections through the eye of (a) *Tursiops truncatus,* (b) *Inia geoffrensis* and (c) *Phoca vittulina* (after FRANZ, 1911).

Discussion

Experiences of zoo veterinarians with captive animals, as well as observations by biologists on wild populations (pers. comm. during eighth E.A.A.M.-meeting) seem to leave no doubt about the high frequency of occurrence of corneal opacities in aquatic mammals, at least as far as cetaceans and pinnipeds are concerned (we have no observations on *Sirenia,* otters and Polar bears). One might argue that a false impression is gained by the fact that many animal species, especially in the wild, will die if visually handicapped, thereby withdrawing from observation, while blind Cetacea and Pinnipedia have shown to survive reasonably well and remain observable. However, experiences with captive animals contradict this argument and support the orginal statement.

An attractive attempt to explain the phenomenon is proposed by BELLHORN c.s. (1977) in their theory of the iris/corneal touch syndrome. According to this theory the chance that the iris makes contact with the cornea is enhanced in marine mammal eyes by two anatomical factors: the shallow anterior chamber and the very vascular iris. During miosis the iris enters the narrow space between lens and cornea. According to the authors the iris vessels become greatly distended in miosis, entailing the risk to touch and damage the inner corneal tissues. Both mentioned anatomical conditions are fulfilled in the "characteristic" cetacean eye (the

Platanistidae are excepted). Firstly, the anterior chamber is extremely shallow (Fig. 4a). In terrestrial mammals comparable conditions are hardly existant. Secondly, the cetacean iris has many anteriorly protruding vessels (Fig. 5); sometimes they even bridge freely over the iris surface.
In *Inia geoffrensis* the iris does not greatly differ from the usual cetacean one. The anterior chamber, however, is as wide as it is in many terrestrial mammals (Fig. 4b). By this fact the touch syndrome theory can not be applied to *Inia*; more probably other reasons, like trauma, must have caused the described synechia anterior in this species.

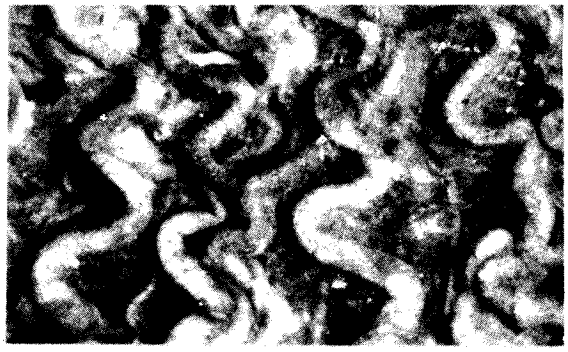

Fig. 5. Frontal view of the iris of *Delphinus delphis.*

Also in pinnepeds the vessels of the iris may protrude into the anterior chamber. The latter, however, can hardly be considered to be shallow (Fig. 4c). Although in these aquatic carnivores the chamber is by far not as deep as in their terrestrial relatives, it is, on the other hand, not shallower than in many ungulates (FRANZ, 1911; ROCHON-DUVIGNEAUD, 1943; WALLS, 1963). In some ungulates the iris carries at the pupillary margin corpora nigra, which protrude into the anterior chamber. These are most developed in tylopods (dromedary, camel, llama), with a relatively shallow eye chamber. In these animals the anatomical conditions seem to be comparable to those in pinnepeds. And also ungulates will meet with various intensities of ambient light, causing the irides to contract and relax. However, as far as we know, corneal opacities are not found frequently in these species.
There are arguments, profferend by BELLHORN c.s. (1977), like location (Fig.1 shows that also in this case the scars are "characteristically" located over the iris operculum) and histopathology of the opacities, which leave little doubt that the iris/corneal touch syndrom plays an important role. However, the comparisons made above make us expect that other reasons cause the syndrome to occur more easily in aquatic mammals than in terrestrial ones. Of course, the aquatic environment is the first suspect. It would be interesting, therefore, to have more information about corneal opacities in *Sirenia,* otters and Polar bears.

References

BELLHORN, R.A., E.P. DOLENSEK and W.S. FLYNN, 1977. Intense miosis as a cuase of opacities in marine mammals. Am. Coll. Vet. Ophthalm., 8th SC programme.
BEUMER, L., A.D.G. DRAL and C.F.G.W. van den HURK, 1972. Ulcus corneae in the Baikal Seal, *Phoca hispida sibirica.* Zool. Garten N.F. 41(5): 244-247.
FRANZ, V., 1911. Studien zur vergleichenden Anatomie der Augen der Säugetiere. Arch. f. vergleich. Ophthalm. II: 269-322.
ROCHON-DUVIGNEAUD, A., 1943. Les yeux et la vision des vertebres. Masson, Paris.
WALLS, G.L., 1963. The vertebrate eye and its adaptive radiation. Hafner, New York, London.